3810-E15

GOOD DESIGN AWARD 2003

Pocket PAL-1

Cat. No. 3810

Instruction Manual

Digital Hand-held
"Pocket" Refractometer

ATAGO®

Introduction

Thank you for purchasing the Digital Hand-held "Pocket" Refractometer, PAL-1. Before operating, read this instruction manual carefully to understand its contents. Keep the manual with the instrument for future reference.

Safety Precautions

To use the PAL-1 safely, the safety precautions described in this instruction manual must be observed. Failure to comply may result in injury and/or damage to property.

⚠ WARNING

◇ When measuring hazardous materials, use proper safety procedures, materials, and clothing to avoid personal injury. Anyone handling hazardous materials should understand its properties and safety requirements.
◇ If the instrument is dropped or subjected to a strong impact, contact your supplier for inspection.
◇ Do not attempt to repair, modify, or disassemble the instrument.

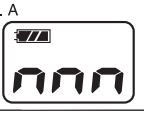
⚠ CAUTION

◇ If this instrument is used to measure highly acidic samples, the prism and sample stage may be damaged, resulting in inaccurate measurements.
◇ The prism is made of optical glass. Do not use any metal tools when applying sample to the prism. The metal can damage the prism surface. If the surface of the prism is scratched or damaged, inaccurate measurements will occur.
◇ When the unit needs to be washed, use water at a temperature not exceeding 30℃.
◇ Before use, carefully read the instruction manual and fully understand the function and operation for each part of the instrument.
◇ Use the battery specified with this refractometer. Insert the batteries properly, paying attention to the polarities.
◇ Do not leave the instrument in a location exposed to direct sunlight or near a heat source for any extended period of time.
◇ Do not change the ambient temperature of the instrument suddenly.
◇ Do not place the instrument where it will be subject to strong vibrations.
◇ Do not use the instrument where there are excessive amounts of dust.
◇ Do not store the instrument in an extremely cool area.
◇ Do not set or drop heavy objects on top of the instrument.
◇ When transporting the PAL-1 on an airplane, remove the batteries and battery case cover and store them in the case provided.

ELI Function

＜If the ELI* function indicates the [nnn] warning message when measuring a sample, shade the sample stage with your hand and repeat measurement. (Fig. A)＞

Fig. A



If the PAL-1 is subjected to intense light, such as direct sunlight or artificial lighting, when measuring a sample, the ELI function will display the [nnn] warning message immediately after the START or ZERO key is pressed. When this happens, shade the sample stage with your hand and press the START or ZERO key again.

— Note —

When intense light penetrates the prism of a digital refractometer, the light waves interfere with the sensor, which may lead to inaccurate measurements. To ensure accurate measurement results, the PAL-1 is programmed with the ELI function which displays the [nnn] warning message when intense direct light is detected. Forming a habit of shading the sample stage with your hand and re-pressing the START key (when the warning message from the ELI function is displayed) will ensure accurate measurement results each time.

* External Light Interference (ELI)

＜International Protection Classification IP65＞

Although the PAL-1 is water resistant and may be cleaned under running water, it is not water proof. Do not submerge the instrument under water.

Contents

The PAL-1 contains the following items:

◆ Pocket Refractometer PAL-1 ·····1
◆ Instruction Manual (this book) ·····1
◆ Size AAA Battery ·····2

Parts

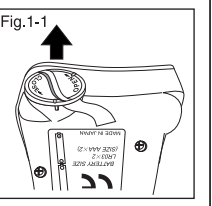
(1) Liquid Crystal Display (LCD)
Displays the measured values, battery indicator and temperature.
(2) Sample Stage
The prism is located at the center of the sample stage.
(3) START Key
Press to begin measurement. To turn off the instrument, press and hold down for two seconds.
(4) ZERO Key
Press to perform zero-setting.
(5) Battery Case Cover
Remove the battery case cover to insert or replace the batteries.
(6) Strap Holder
Attach a strap for increased portability.

1. Inserting Batteries

When inserting batteries for the first time or replacing batteries, this step should be performed in an environment where there is relatively low humidity.

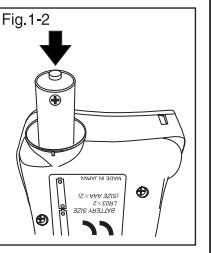
(1) Remove the battery case cover. Be sure to remove the protective tape located on the under side of the cover (Fig.1-1).

Fig.1-1



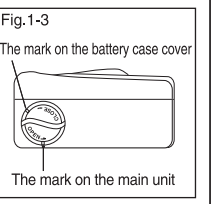
(2) Refer to the illustration located on the back of the unit. Follow this diagram to properly insert the batteries, noting the positive and negative terminals. Insert the two AAA alkaline batteries provided (Fig.1-2).

Fig.1-2



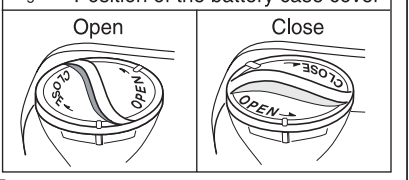
(3) After inserting the batteries, place the battery case cover on the slot, aligning the mark on the battery case cover to the mark on the lower part of the main unit. Then turn the battery case cover towards the right (clockwise), while holding the center tip of the battery case cover with your thumb and index finger and pressing it downwards, until it stops completely (Fig.1-3, 1-4).

Fig.1-3



CAUTION

Fig.1-4 Position of the battery case cover



【CAUTION】

- Confirm that the battery case cover is tightly closed in order to prevent ingress of liquids coming inside the unit which causes unstable electronic connection and not being able to measure. Turn the cover tightly after setting it correctly into the instrument.
- Check that the O-ring located on the battery case cover is clean and free of deformities. If the O-ring is dirty or deformed, water may enter the instrument causing damage to the electronic components (Fig.1-5).
  After opening and closing the cover several times, apply oil (such as Vaseline) on the O-ring with a cotton swab.

Fig.1-5

- Battery Power Indicator
  When the battery power is low, as indicated by the symbol above, replace with new batteries as soon as possible.
  Use only 1.5V AAA batteries.
- When inserting batteries for the first time or replacing batteries, this step should be performed in an environment where there is relatively low humidity.
- Occasionally, the "battery indicator," a character or number mark may be present after the instrument is powered off.
  This occurs due to static electricity and is not a defect in the liquid crystal display (LCD).
  When these marks are present, there is no additional power drain on the battery.
- Always check the expiration date when purchasing batteries.
- Perform Zero Setting after replacing the batteries.

2. Zero Setting

【CAUTION】

- Perform Zero Setting each day prior to using the PAL-1.
- The temperature of the distilled or tap water used for zero-setting should be the same as the ambient temperature. If not, allow the water temperature to adjust to the ambient temperature before pressing the ZERO key to Zero Set.
- If the ELI* function indicates the [nnn] warning message on the LCD screen while performing zero-setting, shade the sample stage with your hand and press the ZERO key again.

(1) Prepare distilled or tap water.

(2) Clean the prism surface (Fig. 2-1).

(3) Place approximately 0.3 ml of water onto the prism surface (Fig. 2-2, Fig. 2-3).

(4) Press the START key. "---" will appear, and then the measured Brix value (%) as well as the temperature of the sample stage at the time the measurement was taken will be displayed.

(5) If the display indicates "0.0%", zero setting does not need to be performed. Wipe the water off of the prism surface with a lint free tissue. The PAL-1 is ready to use.

(6) If the indicated value is not "0.0", press the ZERO key while the water is covering the prism (Fig. 2-4).

(7) After blinking 2 times, "000" will be displayed on the LCD screen (Fig 2-5). If the display reads "AAA", add more water onto the prism surface and press the ZERO key again.

(8) When "000" is displayed, zero setting has been successfully completed. Dry the prism surface by wiping with a tissue. The PAL-1 is ready to use.

Fig. 2-1

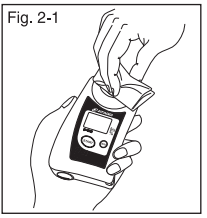


Fig. 2-2

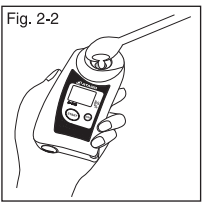


Fig. 2-3

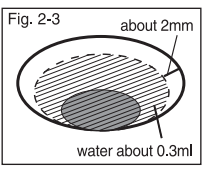


Fig. 2-4

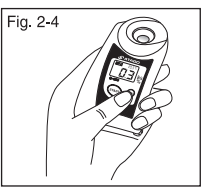
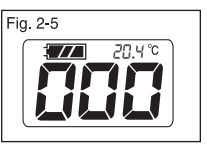


Fig. 2-5



3. Measuring Method

【CAUTION】

- Do not use any metal tools when applying sample to the prism. Metal can damage the prism surface.
- The temperature of the sample should be the same as the ambient temperature. If the temperature is different, allow the sample temperature to adjust to the ambient temperature before pressing the START key to take a measurement.
- The instrument should not come in contact with any sample over 30℃. Warping of the outer casing may occur, which will diminish the water resistant feature of the instrument.
- When measuring a hot, viscous sample, be careful not to spill it outside the metal sample stage. Use a small spoon to apply only enough sample to measure on the prism.
- Avoid using water over 30℃ to clean a sample that has dried and hardened on the prism surface. The proper procedure to clean an encrusted prism surface is to use absorbent gauze dipped in hot water, then carefully wipe the sample off. Avoid wetting the outer casing of the instrument with the hot water. The excessive heat can warp the outer casing, which will diminish the water resistant feature of the instrument.
- If the ELI* function indicates the [nnn] warning message on the LCD screen while measuring a sample, shade the sample stage with your hand and press the START key again.

(1) Clean the prism surface.

(2) Place approximately 0.3 ml of sample onto the prism surface (Fig. 3-1, Fig. 3-2).

(3) Press the START key (Fig. 3-3).

(4) "---" will appear, and then the measured Brix value (%) as well as the temperature of the sample stage at the time the measurement was taken will be displayed (Fig. 3-4).

Fig. 3-1

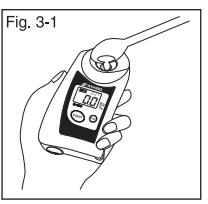
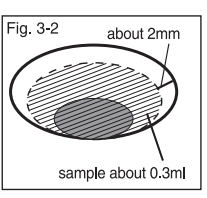
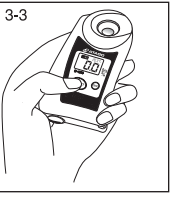


Fig. 3-2



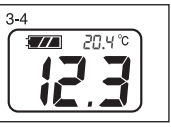
(5) The measured value will remain displayed for approximately 2 minutes. To turn off the display, press and hold down the START key for approximately 2 seconds.

Fig. 3-3



(6) Remove the sample by wiping it off with a tissue. Use water to remove any remaining sample. Dry off any excess moisture with a clean, dry tissue.

Fig. 3-4



The internal temperature of the sample stage is displayed, which may vary from the temperature of the sample itself.

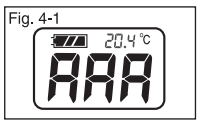
4. Error Messages

Improper operation of the PAL-1 will result in one of the following error messages:

「AAA」 Zero Setting Error (Fig. 4-1)

- There is no water or an insufficient amount on the prism surface while performing zero setting.
- A substance other than water is used to perform zero setting.

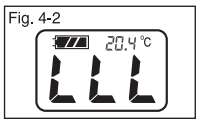
Fig. 4-1



「LLL」 Sampling, Measurement Error (Fig. 4-2)

- There is an insufficient amount of sample on the prism surface to perform measurements.

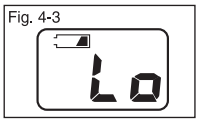
Fig. 4-2



Battery Error (Fig.4-3)

- The following error message will be displayed when the battery power is low, replace with a new battery.

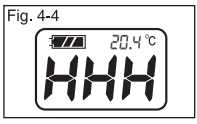
Fig. 4-3



「HHH」 Out of Range (Fig. 4-4)

- The sample's measured value is out of the measurement range.

Fig. 4-4



Measurement Temperature Error (Fig. 4-5 & 4-6)

- If the START key is pressed when the temperature of the prism is below the measurement temperature range, "LLL" is displayed along with the measured Brix value (%). Likewise, if the temperature of the prism is above the measurement temperature range, "HHH" is displayed along with the measured Brix value (%). Measurement values under these conditions are relative.

Fig. 4-5

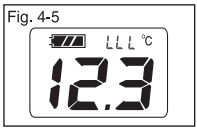


Fig. 4-6

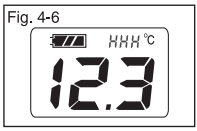
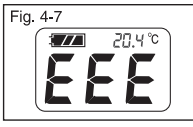


Fig. 4-7



「EEE」 Malfunctioning Error (Fig. 4-7)

- With the instrument turned off, remove and reinsert the battery. In the case of a low battery, replace the battery with a new alkaline AAA battery. If the instrument continues to display the error message, the instrument will need to be repaired. Please contact your Authorized ATAGO Distributor for information on repair.

5. Storage and Maintenance

(1) Store this instrument in a dry and shaded area. A damp storage area may cause the optical system to blur or encourage molding. Extended exposure to direct sunlight may cause the casing to warp.

(2) Do not use organic solvents (paint thinner, benzene, gasoline, etc.) on the instrument because it will severely damage the casing.

(3) Clean the prism surface immediately after completing each measurement. Any sample left on the prism surface for an extended period of time will damage the prism. Clean the prism with water and then dry any excess moisture with a clean, dry tissue.

6. Brix Scale and Automatic Temperature Compensation

(1) Brix Scale
All Refractometers are designed to measure the refractive index of a solution. The Brix scale is based on a sucrose (sugar) and water solution. However, since most samples contain substances other than sugar - such as salts, minerals, and proteins - the Brix percentage represents the total concentration of all soluble solids in the sample. For certain samples, such as cutting oils and other industrial fluids, a conversion chart from the Brix percentage to the sample's total concentration may be necessary.

(2) Automatic Temperature Compensation
The Automatic Temperature Compensation feature of the PAL-1 displays the measured value of the sample at the standard 20℃ (within the measurement temperature range of 10-100℃). As the temperature of a solution changes, so does the refractive index. The Automatic Temperature Compensation feature of the PAL-1 is performed by a temperature sensor which measures the change in prism temperature (when a sample is placed on the prism) and then calculates the actual measured value in relation to the temperature change. Since the prism temperature is changing, allow time for the temperature of the prism and sample to conform for the Automatic Temperature Compensation to work properly.

7. Specifications

Measurement range	Brix 0.0～53.0% Temperature 9.0～99.9℃
Resolution	Brix 0.1% Temperature 0.1℃
Measurement accuracy	Brix±0.2% Temperature ±1℃
Measurement temperature	10～100℃ Automatic Temperature Compensation
Ambient temperature	10～40℃
Sample volume	0.3ml or more
Measuring time	3 seconds
Power supply	AAA alkaline battery × 2
Battery life	About 11, 000 times measurement (when an alkaline battery is used)
International Protection class	IP65 Water Resistant
Dimensions and weight	55(W)×31(D)×109(H)mm, 100g

ATAGO instruments are rigorously inspected to ensure each unit meets the highest standards of quality assurance.

8. Repair and Warranty

The PAL-1 is warranted for one year after the date of purchase against any manufacturer defect in materials or workmanship. Since the PAL-1 is a precise optical instrument, great care must be taken in the instrument's storage and use. If any mistreatment or misuse of the instrument is detected, the warranty will be voided and repair fees will be charged. Ask your supplier for more details.

Have the serial number of your PAL-1 available when asking about repairs.

9. CE Certification

The product is in conformity with the requirements of the EMC Directive 93/68/EEC.

It is applying for the registration of a design and the patent of the Pocket to the all countries around the world. It is registered in China and Taiwan as follows.
Patent for Registration No.: ZL200310103015.2 (China)
Design for Registration No.: ZL03303431.1 (China) and 089244 (Taiwan)

ATAGO CO.,LTD.
Headquarters: 32-10, Honcho, Itabashi-ku, Tokyo 173-0001 Japan
TEL: 81-3-3964-6156 FAX: 81-3-3964-6137
overseas@atago.net http://www.atago.net/

ATAGO U.S.A.,Inc.
TEL: 1-425-637-2107 customerservice@atago-usa.com

ATAGO INDIA Instruments Pvt. Ltd.
TEL: 91-22-2833-8038 / 8076 customerservice@atago-india.com

ATAGO (THAILAND) Co.,Ltd.
TEL: 662-982-8718-9 customerservice@atago-thailand.com

ATAGO BRASIL Ltda.
TEL: 55 16 3916-6000 customerservice@atago-brasil.com

1009K Printed in Japan